

What is claimed is:

1. A storage system for storing data for at least one host computer, said system comprising:
- a plurality of disk drives for storing and supplying said data;
- a switch having a plurality of input and output ports, said switch being connected between said plurality of disk drives and said at least one host computer for at least connecting one of said input ports on which said data was received to one of said output ports;
- an aggregator connected to said switch for at least managing operation of said plurality of disk drives; and,
- operation coordinating logic operatively coupled to coordinate operation of said plurality of disk drives, said switch, and said aggregator in a manner to control flow of certain of said data between said at least one host computer and said plurality of disk drives to be through said switch and not through said aggregator and in a manner which does not change the operation of said at least one said host computers.
2. The storage system of claim 1 and wherein said switch is a fibrechannel switch and said operation coordinating logic utilizes protocol including fibrechannel protocol.
3. The storage system of claim 2 and wherein said fibrechannel protocol includes fibrechannel FC2 frame headers.

1 4. The storage system of claim 3 and wherein each of said frame headers has a
2 predetermined set of information fields.

3
4 5. The storage system of claim 4 and wherein said fields include but are not
5 limited to destination ID, source ID, sequence ID, sequence count, originator's exchange
6 ID, and respondent's exchange ID.

7
8 6. The storage system of claim 5 and wherein said operation-coordinating logic
9 includes mapping logic for generating a mapping command designating said host
10 computer as said source ID, said aggregator as said destination ID and a first particular
11 said originator ID, and further having a mapped destination ID which designates a
12 particular one of said plurality of disk drives which is connected to a particular one of
13 said output ports.

14
15 7. The storage system of claim 6 and wherein said operation-coordinating logic
16 includes unmapping logic for generating an unmapping command designating said host
17 computer as said source ID, said aggregator as said destination ID and said first particular
18 said originator ID whereby the effect of the operation of said mapping command is
19 neutralized.

20
21 8. The storage system of claim 6 and wherein said operation-coordinating logic
22 includes proxy logic for generating a proxy command having said aggregator as said
23 source ID, said particular one of said plurality of disk drives as said destination ID, and

1 said first particular originator ID, and further having a proxy destination ID which
2 designates a particular said at least one host computer.

3
4 9. The storage system of claim 7 and wherein said operation-coordinating logic
5 includes transfer-ready logic for generating a transfer-ready command having said
6 aggregator as said source ID, said particular said at least one host computer as said
7 destination ID, and said first particular said originator ID.

8
9 10. The storage system of claim 7 and wherein said particular said at least one
10 host computer generates data having said at least one host computer as said source ID,
11 said aggregator as said destination ID, and said first particular said originator ID.

12
13 11. The storage system of claim 5 including logic for selecting said certain of
14 said data to obtain particular data words and wherein each of said words is operated upon
15 by said operation-coordinating logic in a manner to steer said each of said such words
16 directly to a particular one of said plurality of disk drives.

17
18
19 12. A computer data storage system wherein said data is grouped in frames,
20 comprising:

- 21 a plurality of disk drives for storing and retrieving said data;
22 an aggregator for managing operation of said plurality of disk drives;

1 each of said frames including a header containing binary fields designating
2 parameters including at least destination ID, said header being associated with that
3 portion of said data contained within said each of said frames, and,
4 a switch connected between said computer, said disk drives, and said aggregator
5 for both controllably selecting certain ones of said frames and flowing said portion of
6 said data grouped in said certain ones and having said aggregator as said destination ID
7 directly between said computer and said plurality of disk drives, whereby data transfer
8 through said aggregator is avoided for said certain ones of said frames.

9
10 13. The system of claim 12 and wherein said switch includes switch control logic
11 arranged to be commanded by said aggregator to selectively switch said certain ones of
12 said frames directly between said computer and said plurality of disk drives and all other
13 of said frames indirectly therebetween through said aggregator.

14
15 14. The system of claim 13 and wherein said switch control logic includes a
16 frame header field selector, an input frame header buffer, and a map table.

17
18 15. The system of claim 14 and wherein said frame header field selector is a
19 frame header mask.

20
21
22 16. In a computer system including a plurality of disk drives for storing and
23 retrieving data grouped in frames each one of said frames having a frame header

1 including an original destination ID, and an aggregator normally arranged to be in the
2 path of said frames flowing between said computer and said plurality of disk drives, a
3 method for enhancing the transfer of said data between said computer and said plurality
4 of disk drives comprising:

5 a. establishing a frame header field selector designating only information
6 relevant to said method;

7 b. receiving each one of said frames including its respective said frame
8 header from said computer;

9 c. using said frame header field selector with each said respective said
10 frame header to obtain a distilled frame header;

11 d. establishing a map table containing sets of frame header fields each one
12 of said sets of frame header fields corresponding to a proxy destination ID of one of said
13 plurality of disk drives;

14 e. searching said map table for a match between said distilled frame
15 header and at least said one of said sets of frame header fields to obtain a matched frame
16 header field set; and,

17 f. substituting said proxy destination ID in place of said original
18 destination ID in said frame header of each one of said frames corresponding respectively
19 to said matched frame header field set, whereby said each one of said frames is forwarded
20 directly to said particular one of said plurality of disk drives and not via said aggregator.

1 17. The method of claim 16 including the operation of forwarding each of said
2 frames other than said frames corresponding respectively to said matched frame header
3 field set to its respective said original destination ID via said aggregator.

4
5 18. The method of claim 16 and wherein the operation of searching said map
6 table utilizes a hash algorithm.

7
8
9 19. In a computer system ~~employing network-attached storage having both disk~~
10 drives and a disk-drive-aggregator attached to said network, a method for enhancing the
11 transfer of data between said computer and said storage comprising:

12 (a) said aggregator determining if overall performance of said computer system
13 shall be increased if said data should be transferred between said computer and said disk
14 drives either directly through said network or indirectly through said network and said
15 aggregator;

16 (b) if the determination made in step (a) is indirectly through said network and
17 said aggregator, then routing said data between said computer and said disk drives
18 through said network and said aggregator; and,

19 (c) if the determination made in step (a) is directly through said network, then
20 sending said data between said computer and said disk drives through said network but
21 not through said aggregator.

1 20. In a computer system employing network-attached storage having both disk
2 drives and a disk-drive aggregator attached to said network, a method for enhancing the
3 transfer of data between said computer and said storage comprising:

4 transferring said data between said computer and said disk drives directly through
5 said network, said data otherwise normally transferring indirectly through said network,
6 by achieving particular cooperation among said aggregator, said network, and said disk
7 drives.

8
9 21. The method of claim 20 and wherein said transferring is performed in a
10 manner not perceptible to said computer.

11
12
13 22. In a computer system including a plurality of disk drives for storing and
14 retrieving data grouped in frames each one of said frames having a frame header
15 including an original destination ID, and an aggregator normally arranged to be in the
16 path of said frames flowing between said computer and said plurality of disk drives,
17 apparatus for enhancing the transfer of said data between said computer and said plurality
18 of disk drives comprising:

19 a. means for establishing a frame header field selector designating only
20 information relevant to said method;

21 b. means for receiving each one of said frames including its respective
22 said frame header from said computer;

1 c. means for using said frame header field selector with each said
2 respective said frame header to obtain a distilled frame header;

3 d. means for establishing a map table containing sets of frame header
4 fields each one of said sets of frame header fields corresponding to a proxy destination ID
5 of one of said plurality of disk drives;

6 e. means for searching said map table for a match between said distilled
7 frame header and at least said one of said sets of frame header fields to obtain a matched
8 frame header field set; and,

9 f. means for substituting said proxy destination ID in place of said
10 original destination ID in said frame header of each one of said frames corresponding
11 respectively to said matched frame header field set, whereby said each one of said frames
12 is forwarded directly to said particular one of said plurality of disk drives and not via said
13 aggregator.

14
15 23. The apparatus of claim 22 including means for forwarding each of said
16 frames other than said frames corresponding respectively to said matched frame header
17 field set to its respective said original destination ID via said aggregator.

18
19 24. The apparatus of claim 23 and wherein means for searching said map table
20 includes means for utilizing a hash algorithm.

25. A computer product for use on a computer system including a plurality of disk drives for storing and retrieving data grouped in frames each one of said frames having a frame header including an original destination ID, and an aggregator normally arranged to be in the path of said frames flowing between said computer and said plurality of disk drives, and a computer usable medium having computer readable program code thereon for enhancing the transfer of said data between said computer and said plurality of disk drives comprising:

- a. program code for establishing a frame header field selector designating only information relevant to said method;
- b. program code for receiving each one of said frames including its respective said frame header from said computer;
- c. program code for using said frame header field selector with each said respective said frame header to obtain a distilled frame header;
- d. program code for establishing a map table containing sets of frame header fields each one of said sets of frame header fields corresponding to a proxy destination ID of one of said plurality of disk drives;
- e. program code for searching said map table for a match between said distilled frame header and at least said one of said sets of frame header fields to obtain a matched frame header field set; and,
- f. program code for substituting said proxy destination ID in place of said original destination ID in said frame header of each one of said frames corresponding respectively to said matched frame header field set, whereby said each one of said frames

1 is forwarded directly to said particular one of said plurality of disk drives and not via said
2 aggregator.

3
4 26. The computer program product of claim 25 including program code for
5 forwarding each of said frames other than said frames corresponding respectively to said
6 matched frame header field set to its respective said original destination ID via said
7 aggregator.

8
9 27. The apparatus of claim 26 and wherein program code for searching said map
10 table includes program code for utilizing a hash algorithm.

11
12
13 28. A computer program product for use in a computer system employing
14 network-attached storage having both disk drives and a disk-drive-aggregator attached to
15 said network, and a computer usable medium having computer readable program code
16 thereon for enhancing the transfer of data between said computer and said storage
17 comprising:

18 (a) said aggregator including program code for determining if overall
19 performance of said computer system shall be increased if said data should be transferred
20 between said computer and said disk drives either directly through said network or
21 indirectly through said network and said aggregator;

1 (b) if the determination made in operation (a) is indirectly through said network
2 and said aggregator, then program code for routing said data between said computer and
3 said disk drives through said network and said aggregator; and,

4 (c) if the determination made in operation (a) is directly through said network,
5 then program code for sending said data between said computer and said disk drives
6 through said network but not through said aggregator.

7
8
9 29. A computer program product for use in a computer system employing
10 network-attached storage having both disk drives and a disk-drive aggregator attached to
11 said network, and a computer usable medium having computer readable program code
12 thereon for enhancing the transfer of data between said computer and said storage
13 comprising:

14 program code for transferring said data between said computer and said disk
15 drives directly through said network, said data otherwise normally transferring indirectly
16 through said network, by achieving particular cooperation among said aggregator, said
17 network, and said disk drives.

18
19 30. The computer program product of claim 29 and wherein both said program
20 code for transferring and the results of the running of said program code for transferring
21 are not perceptible by said computer.

22
Adm A-17